AMENDMENTS TO THE CLAIMS

1. (Currently amended) A material sensing sensor using a thin film bulk acoustic resonator (TFBAR) comprising:

a first ~~thin film bulk acoustic resonator~~ TFBAR for generating a first resonant frequency according to the amount and/or thickness of a target material, wherein the first ~~thin film bulk acoustic resonator~~ TFBAR further comprises a reactive layer; and

a reference thin film bulk acoustic resonator for generating a reference resonant frequency[[.]],

wherein the first and reference TFBARs are formed on a substrate.

2. (Original) The sensor of claim 1 further comprising:

a first channel pattern formed on the first TFBAR and receiving the target material.

3. (Original) The sensor of claim 2 further comprising:

a second channel pattern formed on the reference TFBAR.

4. (Currently amended) The sensor of claim 1 comprising:

~~a substrate;~~

an upper membrane layer formed at an upper surface of the substrate;

a lower membrane layer formed at a lower surface of the substrate;

a common lower electrode formed on the lower membrane layer;

a piezoelectronic material layer formed on the common lower electrode;

first and second upper electrodes formed at prescribed portions on the piezoelectronic material layer;

channel patterns formed in a direction corresponding to the first and second upper electrodes and formed on the lower membrane layer by etching the upper membrane layer and the substrate; and

first and second adsorption layers formed at an upper surface of the lower membrane layer exposed through the channel patterns, wherein the reactive layer is formed on the first adsorption layer.

5. (Currently amended) The sensor of claim 1 comprising:

~~a substrate;~~

an upper membrane layer formed at an upper surface of the substrate;

a lower membrane layer formed at a lower surface of the substrate;

a lower electrode formed on the lower membrane layer;

a piezoelectronic material layer formed on the lower electrode;

a pair of upper electrodes formed on the piezoelectronic material layer;

a pair of channel patterns formed in a direction corresponding to the pair of upper electrodes and formed by etching the upper membrane layer, the substrate and the lower membrane layer to expose the lower electrode, wherein the reactive layer is formed on the lower electrode exposed through one of the pair of the channel patterns.

a reactive layer formed on the lower electrode exposed through one of the pair of the channel patterns.

6. (Currently amended) The sensor of claim 1 comprising:

~~a substrate;~~

a membrane support layer formed on the substrate;

a membrane layer formed on the membrane support layer;

a common lower electrode formed on the membrane layer;

a piezoelectronic material layer formed on the common lower electrode;

first and second upper electrodes formed on the piezoelectronic material layer, wherein the reactive layer is formed on the first upper electrode; and

a chamber structure formed to expose the reactive layer and a portion of the second upper electrode.

7. (Currently amended) The sensor of claim 1 comprising:

~~a substrate;~~

a membrane support layer formed on the substrate;

a common lower electrode formed on the membrane support layer;

a piezoelectronic material layer formed on the common lower electrode;

first and second upper electrodes formed on the piezoelectronic material layer, wherein the reactive layer is formed on the first upper electrode; and

a chamber structure formed to expose the reactive layer and a portion of the second upper electrode.

8. (Original) The sensor of claim 1 is formed as plural ones, and the plurality of material sensing sensors are disposed in a single sensor chip.

9. (Original) The sensor of claim 1 formed as plural ones which are arranged in a lattice form on a single sensor chip.

10. (Original) The sensor of claim 9 further comprising:

a sensor chip package having bonding pads connected to the sensor chip, external connection pins connected to the bonding pads and a structure for protecting and supporting the sensor chip.

11. (Original) The sensor of claim 1 further comprising:

a signal processor for mixing the first resonant frequency and the reference resonant frequency, and measuring the amount and/or thickness of the target material on the basis of a power value of the mixed signal.

12. (Original) The sensor of claim 11, wherein the signal processor comprises:

a sensing oscillator for outputting a first resonant frequency of the first film bulk acoustic resonator of the material sensing sensor;

a reference oscillator for shifting a phase of the resonant frequency of the reference thin film bulk acoustic resonator of the material sensing sensor by 180° to output a reference resonant frequency;

a radio frequency (RF) signal mixer for mixing the first resonant frequency and the reference resonant frequency; and

a power measuring unit for calculating power of the mixed signal.

13. (Original) The sensor of claim 11, wherein the signal processor comprises:

a sensing oscillator for outputting a first resonant frequency of the first thin film bulk acoustic resonator;

a reference voltage control oscillator (VCO) for shifting a phase of the resonant frequency of the reference thin film bulk acoustic resonator by 180° and outputting the phase-shifted reference resonant frequency;

an RF signal mixer for mixing the first resonant frequency of the sensing oscillator and the reference resonant frequency of the reference VCO; and

a power measuring unit for varying a voltage applied to the reference VCO so as for output power of the mixed signal to be minimized,

wherein when the voltage applied to the reference VCO is varied, the adherence amount and thickness of the target material are measured on the basis of the varied voltage value.

14. (Currently amended) A material sensing module using a thin film bulk acoustic resonator (TFBAR) comprising:

a sensor chip including a plurality of material sensing sensors each having a thin film bulk acoustic resonator generating a measurement resonant frequency according to the amount and/or thickness of a target material and a reference ~~thin film bulk acoustic resonator~~ TFBAR generating a reference resonant frequency; and

a signal processor for mixing the measurement resonant frequency and the reference resonant frequency and measuring the amount and/or thickness of the target material on the basis of a power value of the mixed signal,

wherein the ~~thin film bulk acoustic resonator~~ TFBAR generating a measurement resonant frequency comprises a reactive layer[[.]],

and wherein the sensor chip further comprises a substrate.

15. (Original) The module of claim 14, wherein the signal processor is formed together with the sensor chip on the same substrate.

16. (Original) The module of claim 14, wherein a sensor chip package having bonding pads connected to the sensor chip, external connection pins connected to the bonding pads and a structure for protecting and supporting the sensor chip.

17. (Original) The module of claim 16, wherein the sensor chip package is installed together with the signal processor on a printed circuit board and detachably attached to the printed circuit board.

18. (Original) The module of claim 16, wherein the sensor chip is detached from or attached to the sensor chip package.

19. (Currently amended) The module of claim 14, wherein one material sensing sensor in the sensor chip comprises:

~~a substrate;~~

an upper membrane layer formed at an upper surface of the substrate;

a lower membrane layer formed at a lower surface of the substrate;

a common lower electrode formed on the lower membrane layer;

a piezoelectronic material layer formed on the common lower electrode;

first and second upper electrodes formed at prescribed portions on the piezoelectronic material layer;

channel patterns formed in a direction corresponding to the first and second upper electrodes and formed on the lower membrane layer by etching the upper membrane layer and the substrate; and

first and second adsorption layers formed at an upper surface of the lower membrane layer exposed through the channel patterns, wherein the reactive layer is formed on the first adsorption layer.

20. (Currently amended) The module of claim 1, wherein one material sensing sensor in the sensor chip comprises:

~~a substrate;~~

an upper membrane layer formed at an upper surface of the substrate;

a lower membrane layer formed at a lower surface of the substrate;

a lower electrode formed on the lower membrane layer;

a piezoelectronic material layer formed on the lower electrode;

a pair of upper electrodes formed on the piezoelectronic material layer; and

a pair of channel patterns formed in a direction corresponding to the pair of upper electrodes and formed by etching the upper membrane layer, the substrate and the lower membrane layer to expose the lower electrode, wherein the reactive layer is formed on the lower electrode exposed through one of the pair of the channel patterns.

21. (Currently amended) The module of claim 14, wherein one material sensing sensor in the sensor chip comprises:

~~a substrate;~~

a membrane support layer formed on the substrate;

a membrane layer formed on the membrane support layer;

a common lower electrode formed on the membrane layer;

a piezoelectronic material layer formed on the common lower electrode;

first and second upper electrodes formed on the piezoelectronic material layer, wherein the reactive layer is formed on the first upper electrode; and

a chamber structure formed to expose the reactive layer and a portion of the second upper electrode.

22. (Currently amended) The module of claim 14, wherein one material sensing sensor in the sensor chip comprises:

~~a substrate;~~

a membrane support layer formed on the substrate;

a common lower electrode formed on the membrane support layer;

a piezoelectronic material layer formed on the common lower electrode;

first and second upper electrodes formed on the piezoelectronic material layer, wherein the reactive layer is formed on the first upper electrode; and

a chamber structure formed to expose the reactive layer and a portion of the second upper electrode.

23. (Original) The module of claim 14, wherein the signal processor comprises:

a sensing oscillator for outputting a measurement resonant frequency of the measurement film bulk acoustic resonator of the material sensing sensor;

a reference oscillator for shifting a phase of the resonant frequency of the reference thin film bulk acoustic resonator of the material sensing sensor by 180° to output a reference resonant frequency;

a radio frequency (RF) signal mixer for mixing the measurement resonant frequency and the reference resonant frequency; and

a power measuring unit for calculating power of the mixed signal.

24. (Original) The sensor of claim 14, wherein the signal processor comprises:

a sensing oscillator for outputting a measurement resonant frequency of the measurement thin film bulk acoustic resonator;

a reference voltage control oscillator (VCO) for shifting a phase of the resonant frequency of the reference thin film bulk acoustic resonator by 180° and outputting the phase-shifted reference resonant frequency;

an RF signal mixer for mixing the measurement resonant frequency of the sensing oscillator and the reference resonant frequency of the reference VCO; and

a power measuring unit for varying a voltage applied to the reference VCO so as for output power of the mixed signal to be minimized,

wherein when the voltage applied to the reference VCO is varied, the adherence amount and thickness of the target material are measured on the basis of the varied voltage value.